a plurality of spring clip pairs, each of said spring clips having first and second extensions, one of said first and second extensions cooperating with a corresponding one of said recesses and the other one of said first and second extensions corresponding with a corresponding one of said indentations to retains said power module on said heat sinking member and to facilitate heat transfer during operation of said power module; and

wherein each of said spring clips exerts a substantially equal force to retain said power module on said heat sinking member, whereby a substantially liquid proof seal may be formed between said power module and said heat sinking member.

10. (Twice Amended) A method of assembling a cooling assembly system comprising:

locating a power module on a heat sinking member receptive to liquid coolant flow therethrough;

coupling said power module and the heat sinking member using a plurality of spring clip pairs; and

generating a substantially consistent pressure across said power module and the heat sinking member with said plurality of spring clip pairs to form a liquid coolant seal.

REMARKS

This amendment is in response to the Final Office Action mailed on January 2, 2001, wherein Claims 1-12 were rejected. Claims 1 and 10 have been amended and Claims 1-11 remain pending.

Claim Rejections Under 35 U.S.C § 102 and 103

On page 2 of the Office Action, Claim 10 was rejected under 35 USC §102(b) as being anticipated by Omori. The Examiner stated that Omori in Figures 1 and 6-9 discloses the present claimed invention.

On page 3 of the Office Action, Claim 10 was rejected under 35 USC §103 as being unpatentable over Paterson in view of Omori. The Examiner stated that Paterson discloses all the claimed features of the invention with the exception of generating a constant pressure

across the module and the heat sinking member and that Omori in Figures 1 and 6-9 discloses a plurality of spring clips that generate a constant pressure across a module and a heat sinking member for the purpose of supplementing a single spring force so as to provide higher holding reliability.

On page 3 of the Office Action, Claim 11 was rejected under 35 USC §103 as being unpatentable over Paterson in view of Omori as applied to Claim 10 and further in view of Jackson et al or Wolgemuth et al. The Examiner stated that the patent of Paterson as modified discloses all the claimed features of the invention with the exception of a sealing member and that the patents of Jackson et al or Wolgemuth et al in Figures 2 and 3, respectively, disclose that it is known to have a sealing member between a power module and a heat sinking member for the purpose of directly contacting the power module with the cooling fluid.

On page 4 of the Office Action, Claim 11 was rejected under 35 USC §103 as being unpatentable over Paterson in view of Jackson et al or Wolgemuth et al.

On page 4 of the Office Action, Claims 1-9 were rejected under 35 USC §103 as being unpatentable over Wolgemuth et al in view of Kwak. The Examiner stated that the patent of Kwak in Figures 2 and 7 discloses that it is known to have C-shaped spring clips in recesses and indentations for the purpose of securing a power module to a heat sinking member.

On page 5 of the Office Action, Claim 12 was rejected under 35 USC §103 as being unpatentable over Wolgemuth et al in view of Kwak as applied to Claims 1-9 above and further in view of Omori.

Applicants have amended Claims 1 and 10 to better describe the present claimed invention. Claim 1 now includes the limitations of Claim 12 to simplify the amendment and discussion of the claims. Claims 1 and 10 now include the limitation that there is a plurality of spring clip pairs that exert a substantially equal force or pressure to retain said power module on said heat sinking member to form a liquid coolant proof seal. Claims 1 and 10 have also been amended with the term "liquid" to modify the term "coolant flow." The present claimed invention is focused on attaching a power module to a heat sinking member receptive to liquid coolant flow, and forming a seal between the power module and the heat sinking member to

prevent coolant leakage by generating a consistent force or pressure across the power module and the heat sinking member.

Omori discloses a heat sink apparatus with cooling fins coupled to an IC device, as disclosed in column 2, lines 1-4, and column 3, lines 48-57. The heat sink apparatus is mounted to the IC device using a holding member, as disclosed in column 4, lines 1 and 2. The holding member is attached using fixing screws, as disclosed in column 4, lines 16-20. The heat sink apparatus of Omori is fundamentally different than that used in the claimed invention as the Omori utilizes air (a gas) as the coolant. Omori is completely silent with respect to forming a liquid coolant seal or, for that matter, any type of seal. The holding members of Omori merely couple the heat sink on the IC device. Thus, the holding members of Omori are positioning devices that have a fundamentally different form and function than the clips of the present claimed device. Furthermore, the holding members of Omori are attached using fixing screws and are not spring clips as claimed in the present invention. The spring clips of the present invention are superior in function and costs to screws or other threaded fasteners. Unlike screws or other threaded fasteners, the spring clips are self-adjusting and will not loosen or back out over time and also mitigate creep. Thus, Omori does not teach or suggest the present claimed invention of Claim 10.

Paterson discloses only a pair of cooling clips opposed from each other that generate only a single point force on either side of the cooling apparatus and integrated circuit, as disclosed in Figures 1-3 and column 3, lines 62-64. These single point forces will not generate a consistent pressure across the seal between the cooling apparatus and the integrated circuit. The claimed present invention includes a plurality of spring clip pairs that will generate a consistent pressure across a liquid seal to prevent leakage. Thus, Paterson does not teach or suggest the present claimed invention of Claim 10.

Furthermore, the combination of Paterson and Omori does not teach or suggest the present claimed invention of Claim 10. There would be no motivation to combine Paterson and Omori since they deal with different coolant types - air (a gas) and a liquid. The problems associated with a liquid coolant are fundamentally different than using air as a coolant since in an air-cooled system, no seals are needed to prevent air flow, and the present

claimed invention is directed to solving these problems. Air flow is encouraged in Omori over the pin fins, while the present invention segregates the liquid coolant from the electronic devices. Furthermore, Omori, as previously discussed, only discloses a holder that does not contemplate a seal of any kind. Omori utilizes threaded fasteners and a holder (not spring clips) to position an air-cooled heat sink, while the claimed present invention includes spring clip pairs to form a liquid seal. As previously discussed, the spring clip pairs have numerous advantages over threaded fastener holders, and the combination suggested by the Examiner would be inoperative without modifications not taught in the prior art. Accordingly, Claim 10 should be in condition for allowance.

Referring to Claim 1 (now including the limitations of Claim 12), the Examiner in the first Office Action was correct in stating that Wolgemuth et al does not disclose spring clips, recesses, and indentations. Wolgemuth et al and Jackson et al utilize threaded fasteners in a cooling apparatus. Kwak utilizes clip-type clamp springs for preventing chip position deviation, as disclosed in the abstract and column 3, lines 14-16. Kwak, similar to Paterson, discloses only a pair of cooling clips opposed from each other that generate only a single point force on either side of chip. These single point forces will not generate a consistent pressure across the seal between the cooling apparatus and the integrated circuit. Kwak is also completely silent with respect to coupling a power module to a heat sinking member receptive to coolant flow, as the primary purpose of the clips of Kwak is to prevent chip deviation and not to provide a coolant seal. Thus, Wolgemuth et al, Jackson et al and Kwak, singly or in combination, do not teach or suggest the present claimed invention of Claim 1.

Reiterating the arguments concerning Omori, Omori discloses heat sink apparatus with cooling fins coupled to an IC device, as disclosed in column 2, lines 1-4, and column 3, lines 48-57. The heat sink member is mounted to the IC device using a holding member, as disclosed in column 4, lines 1 and 2. The holding member is attached using fixing screws, as disclosed in column 4, lines 16-20. The heat sink apparatus of Omori is fundamentally different than that used in the claimed invention as Omori utilizes air (a gas) as the coolant. Omori is completely silent with respect to forming a liquid coolant seal or, for that matter, any type of seal. The holding members of Omori merely couple the heat sink on the IC device.

Thus, the holding members of Omori are positioning devices that have a fundamentally different form and function than the clips of the present claimed device. Furthermore, the holding members of Omori are attached using fixing screws and not the spring clips of the present invention. The spring clips of the present invention are superior in function and costs to screws or other threaded fasteners. Unlike screws or other threaded fasteners, the clips are self-adjusting and will not loosen or back out over time and also mitigate creep. Thus, Omori does not teach or suggest the present claimed invention of Claim 1.

Furthermore, there would be no motivation to combine Wolgemuth et al, Jackson et al, Kwak and Omori. Wolgemuth et al and Jackson et al use threaded fasteners, Kwak is completely silent with respect to providing a coolant seal, and Omori uses threaded fasteners in combination with a holder and is also silent with respect to providing a coolant seal. There would be no motivation to combine Wolgemuth et al, Jackson et al, Kwak and Omori since they deal with different coolant types - air (a gas) and a liquid. The problems associated with a liquid coolant are fundamentally different than using air as a coolant since in an air-cooled system, no seals are needed to prevent air flow, and the present claimed invention is directed to solving these problems. Air flow is encouraged in Omori over the pin fins, while the present invention segregates the liquid coolant from the electronic devices. Furthermore, Omori, as previously discussed, only discloses a holder that does not contemplate a seal of any kind. Wolgemuth et al and Jackson et al utilize threaded fasteners, and Omori utilizes threaded fasteners and a holder to position an air-cooled heat sink, while the claimed present invention includes spring clip pairs to form a liquid seal. As previously discussed, the spring clip pairs have numerous advantages over threaded fastener holders, and the combination suggested by the Examiner would be inoperative without modifications not taught in the prior art. Accordingly, Claim 1 should be in condition for allowance.

Claims 1 and 10 should now be in condition for allowance, and Claims 2-11 which depend, directly or indirectly, from Claims 1 and 10 should also be in condition for allowance.

Conclusion

The entire Office Action dated January 2, 2001 has been carefully reviewed, and this response is submitted as being fully responsive thereto. In view of the preceding remarks, Applicants respectfully submit that Claims 1-11 are in condition for allowance and respectfully request such action at the Examiner's earliest convenience. If the Examiner believes that personal contact would be advantageous to the disposition of this case, he is requested to call the undersigned at his earliest convenience.

Respectfully submitted,

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CD:plul

Docket # H-204325

VERSION WITH MARKING TO SHOW CHANGES MADE IN CLAIMS

1. (Twice Amended) A cooling assembly comprising:

a heat sinking member having a plurality of recesses defined therein, said heat sinking member receptive to liquid coolant flow;

a power module disposed on said heat sinking member, said power module having a casing with pluralities of indentations therein, said indentations being positioned relative to said recesses to locate said power module on said heat sinking member, and

a plurality of spring [clips] clip pairs, each of said spring clips having first and second extensions, one of said first and second extensions cooperating with a corresponding one of said recesses and the other one of said first and second extensions corresponding with a corresponding one of said indentations to retain said power module on said heat sinking member and to facilitate heat transfer during operation of said power module; and

wherein each of said spring clips exerts a substantially equal force to retain said power module on said heat sinking member, whereby a substantially liquid proof seal may be formed between said power module and said heat sinking member.

10. (Twice Amended) A method of assembling a cooling assembly system, comprising:

locating a power module on a heat sinking member receptive to liquid coolant flow therethrough;

coupling said power module and the heat sinking member using a plurality of spring [clips] clip pairs; and

generating a substantially consistent pressure across said power module and the heat sinking member with said plurality of spring [clips] clip pairs to form a liquid coolant seal.